DEVICE FOR PREVENTING AND TREATING MYOPIA

Field of the invention

This invention generally relates to a vision physiotherapy correcting device, and more particularly to a device for correcting myopia with close de-focusing objects training.

Background Art

Nowadays, 1/3 of the people in the world are suffering from myopia, and the situation is more and more serious. There are not ideal or effective devices for correcting myopia yet. In the past, Shen Zhen Weikang Technology Company produced the "Phoenix Eye 2000", which used red, blue and green vision frequency light to activate the retina and increase eyesight, but the effect is not satisfactory and slow. CN2081103U disclosed a normally worn lens for correcting nearsightedness, the upside of the lens is for correcting farsightedness while the downside is for correcting nearsightedness. However, it's difficult to focus on the object and make the reversed change to correct myopia or control the development, and the multi focus is bad for the youth's eyeball growth. In 1922, Sheard invented "far fogging" by wearing the convex in front of the eyes, which has some effects for correcting the myopia but can not reach a satisfied and stable result, so it couldn't be used widely. From 1980 to 1985, several primary school students had the experiment of wearing 1.5D convex to read and write to correct myopia, which is the "near fogging" method. Actually this method can slow the myopia development a bit, but cannot correct it effectively. Some other therapeutic methods with convex have the same problem and cannot be spread for use.

Summary of the invention

The invention aims at providing a method and apparatus for particular myopia correcting for close de-focusing object training. It will be used particularly for short distance myopia correcting, with characteristics such as prominent effect, fast correcting, no side effect, simple structure, easy to

extend, simple and scientific method. It is especially suitable for the usual prevention and cure of myopia for children and youth, as well as the fast cure of functional myopia.

The technology solution for the invention is: a myopia correcting apparatus particularly for short distance de-focusing object training, including the spectacles frame, lens frame and lenses. The characteristic is that the diopter of the lens is $\Phi=1/u+A+B-\Delta\Phi$, while A is the rectified diopter of farsightedness, B is the de-focusing diopter with a select value between 0.1 and 3D, $\Delta\Phi$ is the modified value, and u is the distance between viewed object and lens in the training. When the eyes are close to the lenses, $\Delta\Phi$ should be about zero, which equals to wearing the glasses; the reducing value $\Delta\Phi$ can be calculated by experiment; when the training position of eyes are far from the lenses, the lens diopter value Φ should also be reduced accordingly, to comply with de-focusing objects above; it can also be calculated according to relevant optical formula, such as $\Delta\Phi=[(1/u+A+B)^2u+2(1/u+A+B)+1/u]/(2+uA+uB+u/s)$, where s is the distance between lens and eye. The lenses can be defined as double eyes double lenses, double eyes single lens, or single eye single lens.

The distance between the object and lenses in the training, u, should be valued between about 130 and about 1000mm.

To improve the applicability and convenience of training reading and writing, the distance (u) between the object and lenses in the training should be valued between about 200 and about 500mm with priority.

To be more applicable and general as well as to improve the prevention effect, the distance (u) between the object and lenses in the training above should be valued between about 250 and about 330mm with priority.

There are distance-control mechanisms such as sound, light, electrical, mechanical, or manual mechanism for the distance (u) between the object and lenses in the training. The mechanism should be able to control the distance between the object and lenses in the training to be within the u value

range, in order to keep the eyes in the condition that they can be trained and relaxed at the same time. To train eyes relaxation, activate the dim adjusting and vision distance adjusting change well or readily by controlling or adjusting distance.

The mechanical distance-control mechanism should be in fixed or adjustable desk frame; the structure should be simple, stable, and convenient. The lens frame is better to be desk frame, which means fixed or adjustable desk frame distance-control structure, or adorn spectacles frame and glasses (such as glasses with stands or headgear), and there should be a distance-control ruler, or other flexible measurement control, on it.

It is better to set a loading plate (or platform) under the fixed and adjustable desk frame, where visible objects such as a vision mark can be put. The loading platform should be configured with up and down mechanism, to help trainers adjust the position for easily training.

The lenses can be single lenses or equivalent diopter compound lenses. With a view to a better effect, the lenses should be compound lenses which include ocular and object lenses. The ocular is Φ2 convex, the object lens is Φ1 concave mirror, the distance between the ocular and object lenses should be fixed or adjustable, which can be calculated with the formula $\Phi=(\Phi1+\Phi2-\Phi1\Phi2\Phi d)/1-\Phi1d$ (d is the distance between ocular and object lenses); at this time u should be the distance between the viewed object and ocular in training; the light blocker can be added between the ocular and object lenses. The lenses can also be alternative series lenses or focus-adjustable lenses.

The viewed objects in question could also be books. To improve the eye accommodation training effect in proper space frequency, the special vision mark is favorable for the above-mentioned viewed object.

The above-mentioned special vision mark may consists of line drawings, regular letters, numbers or characters (i.e. article) of different or the same size, such as a graphic micro-vision chart or a booklet of vision marks.

The special vision mark could be an LCD screen of a play station with consideration for increase of interests and attention of the patient, improvement of the vision psychological effect, insurance of the training time or the combination of learning and reading training.

The above-mentioned special vision mark may be a single vision mark for double eye or single eyes; however, double vision marks are preferred. Double vision marks are in paralleled, placed for double eye double lens coincidence, which is easy for double eye coincidence training and convenient for double eye parallel sight, resulting in the reduction of the concentration and the convergence adjustment of double eyes to help the eyes relaxation, adjustment, and change of farsightedness. The center to center distance between the two vision marks is between about 20 ~ about 100mm, and the two vision marks could be the same or different, which is judge by the principle of convenient coincidence.

For the improvement of correcting effect in single vision coincidence training, the concentration and convergence adjustment of double eyes should be minimized to help the eyes relaxation, adjustment, and change of farsightedness; or for the better formation of double vision marks. The above mentioned two lenses should be with a composite prism towards to the sides of nose or inner downward, the degree of prism $P=3^{\Delta}\sim15^{\Delta}$ to be better, also can be $P=50\times d_1/u$, where d_1 is the distance between eyes for far sight, u is the distance between the vision mark and the front lens; or the two lenses can be two de-centered lenses.

To prevent the near perceived accommodation of human eyes, the blockers can be placed around the lens within the device for concentration and better effect. In the case of the double vision mark, a mechanism to avoid sight intersection can be added, such as a vertical sight spacer (or barn door), to prevent the sight interference caused by eye sight's crossed diplopia.

The method with the adoption of myopia correcting apparatus particularly for short distance de-focusing object training, includes:

A is confirmed for the nearsightedness degree of trainee.

Select the value of distance (u) between viewed object and lens in training referring to the habit and necessity for short-distance work and study.

Choose a value for B and $\Delta\Phi$;

With the above-mentioned values of A, u, B and $\Delta\Phi$, the value of diopter Φ can be calculated via the formula $\Phi=1/u+A+B-\Delta\Phi$ for selection of the training apparatus;

Place a viewed object in front of the lens, and set the distance between the viewed object and lens as u; Adjust the distance (u) between the object and lenses with the means of sound, light, electrical, mechanical, or manual methods at the time of training.

Trainee observes the viewed object in question through the said lens and repeats above training until a clear vision of the viewed object can be obtained.

Repeat above procedures with gradual increase of diopter Φ of lens. Through the training, the trainee sight could be expected to reach the desired status step by step; Provided there are no changes upon the diopter Φ of lens, through the regulation of u, the de-focusing object training still can be performed referring to the formula and the renewed A.

Thus, this method is designed based on the diopter of the lens, $\Phi=1/u+A+B-\Delta\Phi$, $\Delta\Phi$ is the revised value; when the eyes are close to the lens, at this time, equivalent to the adorn spectacles; when the eyes are far away from the lens in training, the diopter Φ of lens should be decreased accordingly to produce the same effect of as above of de-focusing the object (decreasing the $\Delta\Phi$ obtained from the experiment); also can be calculated from relevant optical formula, such as $\Delta\Phi=[(1/u+A+B)^2 u+2(1/u+A+B)+1/u] /(2+uA+uB+u/s)$, where S is the distance between the lens and the eyes. The training distance should be determined first for the distance (u) between the viewed object and the lens with respect to the necessity of working and studying in short distance, that is the distance (u) between the viewed object and the lens for training. The range of u is within about 300~1000mm, about 200~500mm, or about 250~330mm. B value is still required, which is determined by the difficulty for the judgment of the viewed object, in the case of hard to distinguish,

choose the lower limit, if comparatively easier, choose the upper limit; determine Φ by the formula Φ=1/u+A+B-ΔΦ; under this rule, exercise the de-focusing training cure in the event of working and studying in short distance. In the case of sight recovery, for the further sight improvement, the distance (u) between the viewed object and the lens in training can be adjusted according to the formula and the recovered A to keep on the de-focusing object training, or change Φ by the formula Φ=1/u+A+B-ΔΦ and u can be held constant and keep on the de-focusing object training with the recovered A and the formula. By using distance-control mechanisms such as sound, light, electrical, mechanical, or manual mechanism to adjust the distance (u) between object and lenses in the training.

The design and cure mechanism of the invention is: this invention is designed particularly for the short distance training, reading, and writing, to frequently maintain the eyes at the status of de-focusing, that is to say, the formation focus is within vitreous rather than retina, the de-focusing vision formed on the retina discontinuously activates the blur adjustment and far vision adjustment of human eyes. Such long term exercise can fulfill the goal to prevent and cure nearsightedness.

The static diopter of normal eyes can make the parallel-entered sight focus on the retina and without dynamic refraction adjustment. For the recovery of the function, the long time of near diopter accommodation should be avoided and the parallel sight is preferred. While for the patient of myopia, the ciliary muscle of eyes is in spastic condition, and it is very obvious in the experiment that only the reduction of near vision accommodation cannot work, when the eye is in the state of de-focusing the object for far vision, that is to produce the far vision "blur adjustment" through the lens and the formation of eyes diopter system within the vitreous in front of the retina, as a result, the ciliary muscle can be relaxed toward the normal condition and the spastic state can be released fast and effectively. Therefore, only convex lens of low degree applied in short distance to reduce the eyes accommodation is useless. Even when convex lenses of medium and low degree are applied, and near vision observation is performed liberally with the absence of consideration for the

distance of the viewed object, the ideal or reliable effect cannot be guaranteed; the specific distance for the use is the first thought. The effective de-focusing object can be achieved through the match of the specific lens to the right distance. The diopter B of de-focusing should be within about 0.1~3D or about 0.25~3D; if less, e.g. about 0.1~1D, easy to distinguish, clear feeling and suitable for long time training and learning; if less than about 0.1D, none of the de-focusing might occur because the reversed adjustment therapy cannot be activated; if too large, e.g. about 2~3D, the blur feeling is smart, too more training load, eye strain easily arises, so the period for training should not be too long; if larger than about 3D, unable to distinguish because of de-focusing too lager, the learning and training is not applicable and further more, empty-space myopia might occur, it should also be avoided; around about1D is OK for general condition. That is the prevention and cure mechanism for the de-focusing object. For the rigid constraints on the distance for use, only manual control is still not enough. The distance-control mechanism is designed to meet the requirement. In the beginning, people feel that the vision mark is not clear enough, however, after watching for a long time and concentrating, the object becomes more clear and obvious. That is the process of far vision accommodation. It can promote the eyes to dynamically adjust the diopter to be zero or reversely change, and suspend the growth of axis oculi and enhance the capability of far vision accommodation through the de-focusing image on the retina, which leads to the farsightedness, so the prevention and cure to the structural myopia can be realized. Shoeffel and schmid used convex lenses and concave lenses on chicken eyes to perform the de-focusing experiment of animal eyes in 1998 and 1996 respectively. The success of treating animal farsightedness and nearsightedness provides the evidence of anatomy experiment that the de-focusing object can change the diopter and sightedness of animals.

Vision mark effect is to make the patient concentrate on the reading therapy. It can activate the interest and enthusiasm of patient in training, with the use of different vision space frequency and the symbols of various difficulty to identify in the exercises, which guides the patient intentionally

towards to the symbols that are hard to identify, consequently the virtuous accommodation of eyes might occur to trigger the enthusiasm of the patient for therapy, that is in the light of the principle of psychology and vision biology.

The major factors for myopia are: (1) Genetic and evolutionary factors; and (2) Environmental factors. The genetic factor is the inner cause from the human and is unchangeable, which determines the potential for the occurrence and development of myopia, while it is also affected and activated by the environmental factors. The environmental factor is the outer cause, the eyes are the light sensor, which are changed and developed according to the exterior light situation. Emitting light from the near environment results in near vision adjustment; the parallel light of far vision and the de-focusing on the sides of vitreous in front of the retina bring forward the reverse change. Long term near vision and less far vision make the inner cause effect and result in the development and genetic change of nearsightedness as eye compensation. So the environment and light are the key cause to the disease, as well as the key for the prevention and cure. Thus the change of environment is a must, from near vision to far vision (or simulating far vision to change the emitting angel of light in eyes), it can develop the potential for farsightedness and suspend the nearsightedness.

When the healthy eyes watch the far point, eyes adjustment is relaxed and the concentration of eyes is zero, the viewed object is formed at the fovea of eyes; in the case of near point, the concentration and adjustment of eyes are interacted accordingly to keep the formation of single eye and center vision. The change upon the environment for the use of the eyes and the unreasonable use of the eyes, the biologically unqualified use begins particularly from childhood, resulting in the decreased chance of far sight, which causes the human optic nervous system to be more and more adaptable to the emitting light of near vision, and resulting in the fast growth and development of nearsightedness.

The multiple animal experiments on chickens, infant monkeys, and cats, anatomy research and a mountain of statistical materials of nearsightedness principles have provide a firm ground: the

major cause of nearsightedness is resulted from long term near vision. In contrast, if long time eye concentration and positive adjustment can be avoided and do more reverse adjustment to produce the compensation, it is helpful to prevent and cure the myopia.

From the view of ophthalmology neurology theory, the concentration and the adjustment of human eyes and the constriction of the pupils are correlated, and according to the Donders line we can know when the concentration of emmetropia is zero, the corresponding adjust is zero, so in the case of larger concentration, the larger the adjustment is. The reason of accommodative myopia is just the near vision for a long time and over concentrated and adjustment, as a result the adjustment is of no use for relaxation and the mismatch of adjustment and concentration. After the change of concentration to zero through human adjustment, then the de-focusing training will promote the adjustment to be zero to comply with the original corresponding principle. Such training can let the adjustment return to normal, and return to original collocation rule so that it can prevention and cure the myopia. The effect of the Double vision marks combine with the triangular prism can achieve this purpose.

A lot of practices reveal that the prominent effect and the characteristics of the invention are: be particular for myopia correcting training, with characteristics such as, fast correcting, safe and reliable, simple structure, no side effect, easy to extend, simple and scientific method. Generally, most child myopia can be improved to about 1.5 within about 3 months.

Accompanied with the diagrams, the detailed description of implementation is given below, but this invention is not limited by this.

Brief Description of the Drawings

Figure 1 shows the schematic view of double lenses single vision mark desk cure apparatus of this invention.

Figure 2 shows the schematic view of double lenses double vision marks desk cure apparatus

of this invention.

Figure 3 shows the schematic view of single lens single vision mark desk cure apparatus of this invention.

Figure 4 shows the schematic view of double lenses single vision mark adorn spectacles cure apparatus of this invention.

Figure 5 shows the schematic view of double lenses double vision marks adorn spectacles cure apparatus of this invention.

In FIGS: 1 – Blocker Spectacle Frame 2 – Double Convex Lenses 3 – Adjustable Desk Frame 4 – Micro LCD Gameboy Screen Single Vision Mark 6 – Tri-lever Adjustable Support 7 – Double Vision Marks 8 – Anti Eye Sight Interleave Spacer 9 – Single 4D Convex Lens 10 – Bio-lever Adjustable Support 11 – Book Single Vision Mark 12 – Distance-Control Ruler 13 – Single Vision Mark 14 – Stands Frame 15 – Mobile restricting lens and monochromatic lens 16 –Anti Eyes Sight Interleave Reflection Blocker Baffle 17 – Therapeutic Pull Rod Telescopic Distance-Control Ruler Connected to Spectacles 18 – Interior Built Vision Mark Illumination Monochromatic Light 19 – Loaded with Two Same Parallel Micro Eye Chart Transparent Vision Mark Box 31 – Adjusting Hand Wheel 32 – Pinion 33 – Track Slide 34 – Rack 35 – Cone Screw

Detailed Description

As shown in FIG 1, 1 is blocker frame, double convex lenses 2 are 4D9Δ, mode distance-control is adjustable desk frame 3: Track and rack 34 and track slide 33 are on the support; Pinion 32 and rack 34 are in mesh; Pinion 32 is connected with track slide 33 through axis lever; the support of track slide 33 is connected with blocker frame 1; Adjusting hand wheel 31 is on the axis lever of pinion 32 to lift and drop the pinion 32 along with rack 34; Adjusting cone screw 35 on track slide 33 is to adjust the frication between track slide 33 of belt fasten structure and the tracks to slide or lock; 4 is micro LCD game screen single vision mark; 5 is the control key of LCD gameboy; According to the formula $\Phi=1/u+A+B-\Delta\Phi$, when A is about -1.00D, B is about 2D, $\Delta\Phi$ is about zero, u is about 330mm. If A is about -3.00D, other values unchanged, the double convex lens 2 can be replaced with 2D9Δ; if A is about -3.00D, the double convex lens 2 is 3D9Δ, the value of u will be about 250mm, others will not be changed.

As shown in FIG 2, the double convex lens 2 is about 10D, the mechanical distance-control is tri-lever adjustable support 6, the double vision marks 7 are on the desk plate, a vertical anti eyes sight interleave baffle 8 is set in the middle of two lenses; if u is about 130mm, B is about 3D, thus A can be about –0.7D.

As shown in FIG 3, 9 is about 4D convex lens single let, mechanical distance-control is bio-lever adjustable support 10, the book single vision mark 11 is on the desk plate; either single eye or both eyes training is applicable; if u is about 200mm, B is about 3D, thus A can be about –4D.

As shown in FIG 4, the double concave lens 2 is about 3.5D3Δ with standing frame, mechanical distance-control is distance-control ruler 12 which is connected to the single vision mark plate 13; if u is about 1000mm, B is about 3D, thus A can be about –0.5D.

As shown in FIG 5, the double concave lens 2 is about –2D, 14 is standing frame, the anti eyes cross sight reflection blocker baffle 16 is set in the middle of two lenses 2, the mobile restricting

lens 15 is placed between two lenses 2 and blocker baffle 16 for the ease of single eye training. Mechanical distance-control mechanism is the therapeutic pull rod telescopic distance-control ruler 17, 19 is the transparent vision mark box which is loaded with two same parallel micro eye charts, 18 is interior built vision mark illumination monochromatic light; if u is about 500mm, B is about 1D, thus A can be about –5D. Training should be performed in the light of above stated methods.

Interior Experiment Condition.

The number of people to be tested; Testing object: children (boys and girls); Age: about 6~14 years old; the degree of myopia is about 0.06~0.8; training method: unified training about once or twice a week, about 2 hours each, individual about 1.5 hour training at home, lasting for a year. Standard: by measuring farsightedness according to the international standard, and adopting the retinoscopy to improve 3 behavior effectiveness, about 1.0 or above means recovery (cured); the unit to perform the interior experiment: some pediatrics academy.

For the result of therapeutic experiment, please refer to Diagram 1.

For the therapeutic instance of students who join in the training after receiving dilated pupil therapy, please refer to Diagram 2.

Table 1

total amount of eyes (unit)	effective (unit)	percentage of effect (%)	cure (unit)	percentage of cure (%)	length of myopia	age (year)
280	269	96	191	68	one year and above	6~14
200	200	100	170	85	less than one year	6~14

Table 2

serial number	name	degree of right eye before treating	degree of left eye before treating	degree of right eye after treating	degree of left eye before treating	improved number of rows right	left	serial number	name	degree of right eye before treating	degree of left eye before treating	degree of right eye after treating	degree of left eye after treating	improved number of rows right	left
1	Zhang ××	0.15	0.15	0.5	0.5	5	5	20	Liu ××	0.12	0.6	0.3	1.2	4	3
2	Liu ××	0.15	0.10	1.0	1.0	8	10	22	Wang ××	0.25	0.2	0.5	0.5	3	4
3	Zhong ×	0.25	0.6	1.0	2.0	6	5	22	Zhang ××	0.25	0.3	0.6	0.6	4	3
4	Liu ××	0.15	0.25	0.8	0.8	5	5	23	Liang ××	0.06	0.1	1.0	1.2	11	11
5	Luo ××	0.1	0.06	0.5	1.0	10	11	24	Feng ××	0.25	0.3	0.6	0.8	4	4
6	Hao ××	0.1	0.25	0.4	0.6	6	4	25	Ren ××	0.12	0.2	0.3	0.4	4	3
7	Wang ××	0.25	0.4	0.8	0.8	5	3	26	Li ××	0.15	0.2	0.4	0.4	4	3
8	Zhou ××	0.12	0.2	0.8	0.8	8	6	27	Xing ×	0.8	0.6	1.5	1.2	3	3
9	Li ××	0.5	0.5	1.2	1.2	4	4	28	Tuo ××	0.15	0.2	0.8	0.8	7	6
10	Hao ××	0.25	0.5	1.0	0.8	6	2	29	Yuan ××	0.25	0.2	1.2	1.2	7	8
11	Liu ××	0.2	0.15	1.0	1.0	7	8	30	Li ××	0.12	0.12	0.6	0.6	7	7
12	Zhang ×	0.12	0.12	0.5	0.5	6	6	31	Zhang ××	0.8	0.8	2.0	2.0	4	4
13	Ma ××	0.3	0.25	1.0	1.0	5	6	32	Liu ××	0.3	0.25	0.8	0.8	4	5
14	Ling ××	0.25	0.25	2.0	2.0	9	9	33	Ren ×	0.25	0.25	1.0	1.0	6	6
15	Li ××	0.4	0.25	0.8	0.5	3	3	34	Ma ××	0.2	0.2	0.6	0.6	5	5
16	Jun ××	0.15	0.25	0.6	0.6	6	4	35	Liu ××	0.6	0.5	1.2	1.2	3	4
17	Duan ××	0.15	0.12	0.5	0.5	5	6	36	Li ××	0.4	0.3	1.0	0.6	4	3
18	Gao ××	0.15	0.2	0.6	0.6	6	5	37	Guo ××	0.4	0.8	0.8	1.5	3	3

19	Qiao ××	0.4	0.3	0.8	1.0	3 5	38	Liu ××	0.4	0.5	1.2	1.2	5 4